Learning signal processing in Persian language

Step 1: Ensemble Empirical Mode Decomposition

ساناز جواهریان

دانش‌آموخته کارشناسی ارشد مهندسی پزشکی

دانشکده مهندسی برق و کامپیوتر دانشگاه تهران

برای حل مشکل تخلیط IMFها و نیز کاهش اثر نویز بر روی IMFها ،مراحلی را به الگوریتم EMD اضافه کرده اند که با نام EEMD شناخته میشود.

الگوریتم این روش ساده است و به صورت زیر عمل میکند:

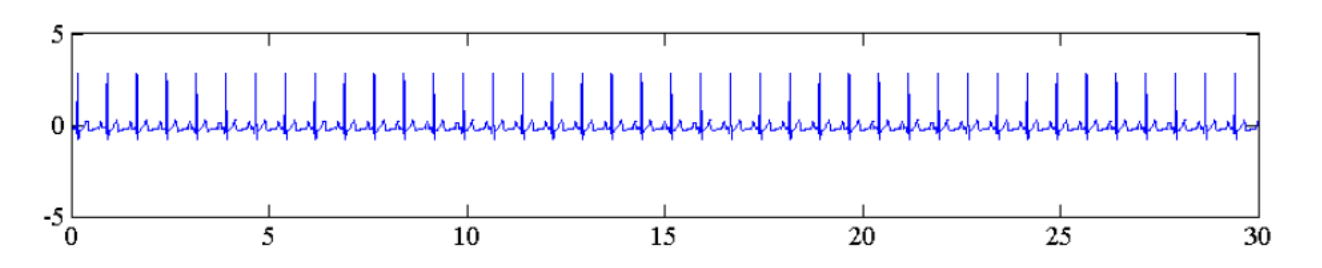
1- اضافه کردن نویز سفید به سیگنال

2- تجزیه کردن سیگنال با نویز سفید گوسی اضافه شده به وسیله ی روش EMD به IMF ها

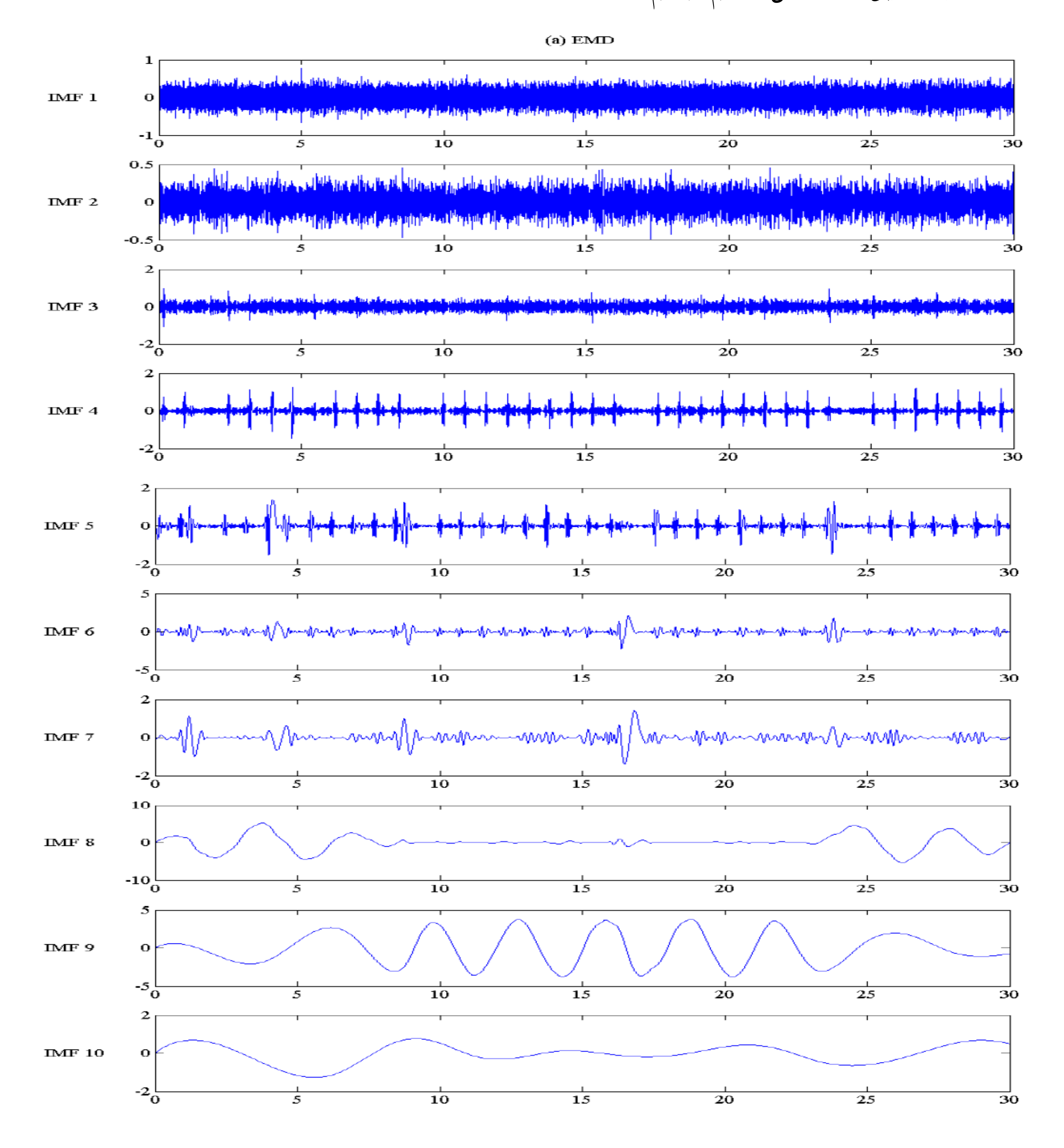
3- تکرار چند باره ی مرحله ی 1 و 2 با نویز های سفید گوسی گوناگون

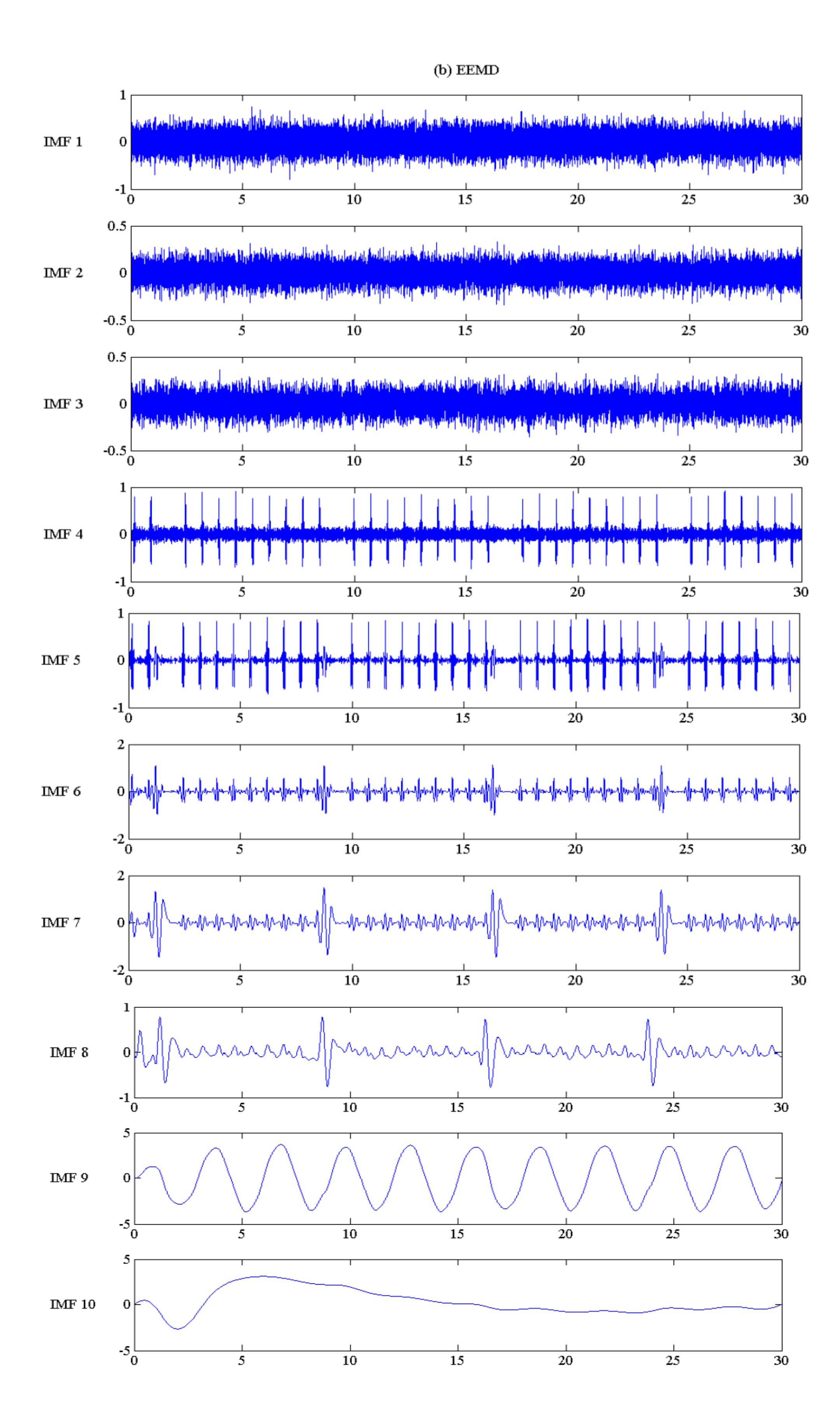
4- محاسبه ی میانگین IMFهای هم شماره حاصل از مرحله ی 3 و درنظر گرفتن میانگین ها به عنوان IMFهای نهایی

شکل زیر یک سیگنال ECG را نشان میدهد:



به سیگنال بالا مقدار 2db نویز اضافه میکنیم و سپس با استفاده از روش های EMD و EEMD به ترتیب آنرا به IMF های تشکیل دهنده اش تقسیم میکنیم.




(b) EEMD
IMF 1
IMF 2
IMF 3
IMF 4
IMF 5
IMF 6
IMF 7
IMF 8
IMF 9
IMF 10
0
5
10
15
20
25
30

References

1. Akbari, H., M.T. Sadiq, and A.U. Rehman, Classification of normal and depressed EEG signals based on centered correntropy of rhythms in empirical wavelet transform domain. Health Information Science and Systems, 2021. 9(1): p. 1-15.

2. Akbari, H. and M.T. Sadiq, Classification of Seizure and Seizure Free EEG Signals Based on second-order difference plot of DWT coefficients. 2020.

3. Akbari, H., Classification of Seizure and Seizure Free EEG Signals using Geometrical features derived from Poincaré plot, and binary particle swarm optimization.

4. Akbari, H., S.S. Esmaili, and S.F. Zadeh, Classification of seizure and seizure-free EEG signals based on empirical wavelet transform and phase space reconstruction. arXiv preprint arXiv:1903.09728, 2019.

5. Ghofrani, S. and H. Akbari. Comparing nonlinear features extracted in EEMD for discriminating focal and non-focal EEG signals. in Tenth International Conference on Signal Processing Systems. 2019. International Society for Optics and Photonics.

6. Akbari, H. and M.T. Sadiq, Detection of focal and non-focal EEG signals using non-linear features derived from empirical wavelet transform rhythms. Physical and Engineering Sciences in Medicine: p. 1-15.

7. Akbari, H., S. Saraf Esmaili, and S. Farzollah Zadeh, Detection of Seizure EEG Signals Based on Reconstructed Phase Space of Rhythms in EWT Domain and Genetic Algorithm. Signal Processing and Renewable Energy, 2020. 4(2): p. 23-36.

8. Akbari, H. and S. Ghofrani, Fast and accurate classification f and nf EEG by using sodp and EWT. International Journal of Image, Graphics and Signal Processing (IJIGSP), 2019. 11(11): p. 29-35.

9. Hussain, W., et al., Epileptic seizure detection using 1 D-convolutional long short-term memory neural networks. Applied Acoustics, 2021. 177: p. 107941.

10. Sadiq, M.T., X. Yu, and Z. Yuan, Exploiting dimensionality reduction and neural network techniques for the development of expert brain–computer interfaces. Expert Systems with Applications. 164: p. 114031.

11. Sadiq, M.T., et al., Identification of Motor and Mental Imagery EEG in Two and Multiclass Subject-Dependent Tasks Using Successive Decomposition Index. Sensors, 2020. 20(18): p. 5283.

12. Sadiq, M.T., et al., A Matrix Determinant Feature Extraction Approach for Decoding Motor and Mental Imagery EEG in Subject Specific Tasks. IEEE Transactions on Cognitive and Developmental Systems, 2020.

13. Sadiq, M.T., et al., Motor imagery BCI classification based on novel two-dimensional modelling in empirical wavelet transform. Electronics Letters, 2020.

14. Sadiq, M.T., et al., Motor imagery EEG signals classification based on mode amplitude and frequency components using empirical wavelet transform. IEEE Access, 2019. 7: p. 127678-127692.

15. Sadiq, M.T., et al., Motor Imagery EEG Signals Decoding by Multivariate Empirical Wavelet Transform-Based Framework for Robust Brain–Computer Interfaces. IEEE Access, 2019. 7: p. 171431-171451.

16. Arianpour, Y., S. Ghofrani, and H. Amindavar. Locally nonlinear regression based on kernel for pose-invariant face recognition. in 2012 11th International Conference on Information Science, Signal Processing and their Applications (ISSPA). 2012. IEEE.

17. Sharma, M. and U.R. Acharya, Automated detection of schizophrenia using optimal wavelet-based l1 norm features extracted from single-channel EEG. Cognitive Neurodynamics, 2021: p. 1-14.

18. Sharma, M., et al., An automated diagnosis of depression using three-channel bandwidth-duration localized wavelet filter bank with EEG signals. Cognitive Systems Research, 2018. 52: p. 508-520.

19. Sharma, M., et al., An automatic detection of focal EEG signals using new class of time–frequency localized orthogonal wavelet filter banks. Knowledge-Based Systems, 2017. 118: p. 217-227.

20. Sharma, M., et al., Dual-tree complex wavelet transform-based features for automated alcoholism identification. International Journal of Fuzzy Systems, 2018. 20(4): p. 1297-1308.

21. Sharma, M., R.B. Pachori, and U.R. Acharya, A new approach to characterize epileptic seizures using analytic time-frequency flexible wavelet transform and fractal dimension. Pattern Recognition Letters, 2017. 94: p. 172-179.

22. Sharma, M. and R.B. Pachori, A novel approach to detect epileptic seizures using a combination of tunable-Q wavelet transform and fractal dimension. Journal of Mechanics in Medicine and Biology, 2017. 17(07): p. 1740003.

23. Sharma, M., D. Deb, and U.R. Acharya, A novel three-band orthogonal wavelet filter bank method for an automated identification of alcoholic EEG signals. Applied Intelligence, 2018. 48(5): p. 1368-1378.